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McAleer

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(54) **SYSTEM AND METHOD FOR CORRECTING SCRAMBLED MESSAGES**

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G06F 11/00 (2006.01)
G06F 11/07 (2006.01)
G06F 11/26 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 11/07*** (2013.01); ***G06F 11/26*** (2013.01)

(58) **Field of Classification Search**
CPC G06F 11/07; G06F 11/2017; G06F 11/26; G06F 11/28; G06F 11/0736; G06F 11/3003; H04L 1/00
USPC 714/2, 48–50, 746, 758, 763, 774
See application file for complete search history.

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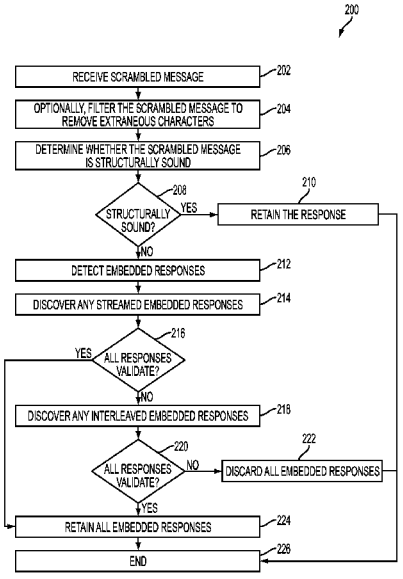
(57) **ABSTRACT**

In one embodiment, a method includes receiving a scrambled message over a network connection. The method further includes detecting one or more embedded responses in the scrambled message. In addition, the method includes discovering any streamed embedded responses of the one or more embedded responses. Further, the method includes, responsive to the discovering of any streamed embedded responses, determining whether all of the one or more embedded responses validate. Moreover, the method includes, responsive to a determination that fewer than all of the one or more embedded responses validate, discovering any interleaved embedded responses of the one or more embedded responses. The method also includes, responsive to the discovering of any interleaved embedded responses, determining whether all of the one or more embedded responses validate. Additionally, the method includes, responsive to a determination that all of the one or more embedded responses validate, retaining the one or more responses.

20 Claims, 5 Drawing Sheets



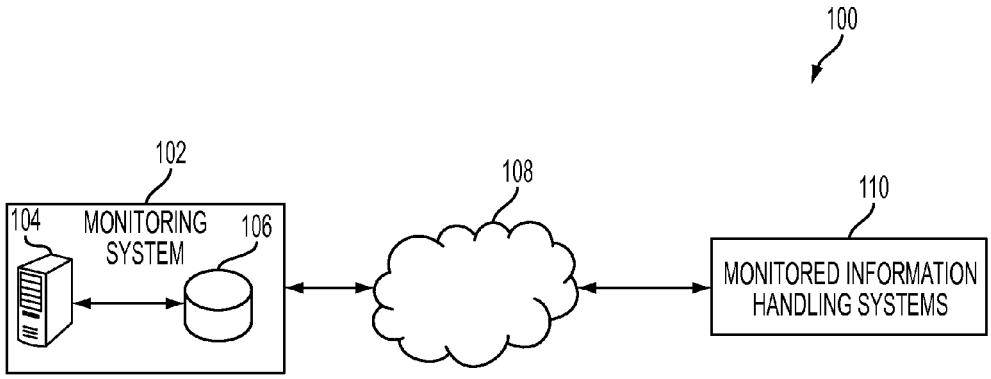

100
102
MONITORING SYSTEM
104
106
108
110
MONITORED INFORMATION HANDLING SYSTEMS

FIG. 1

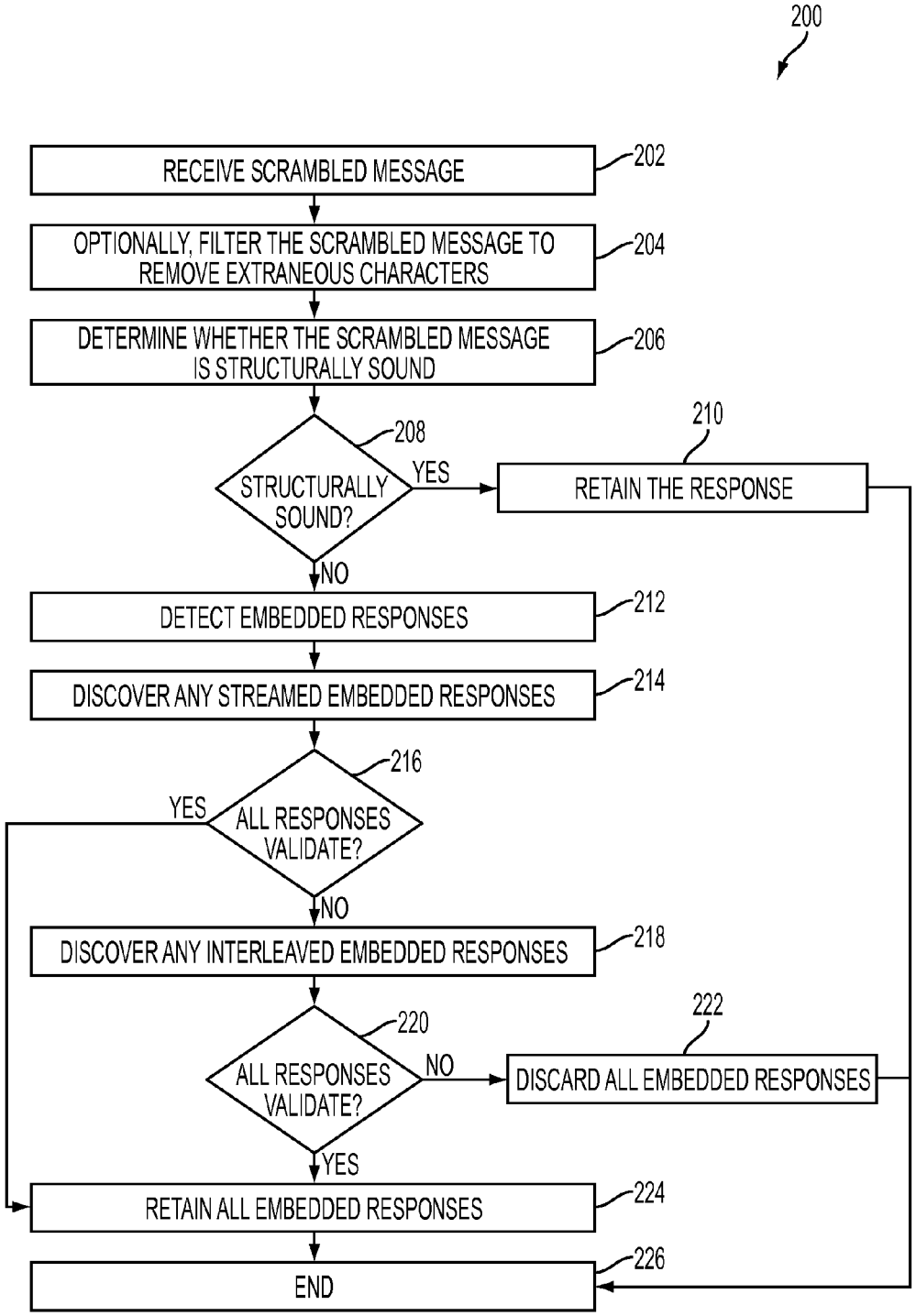

200
RECEIVE SCRAMBLED MESSAGE
202
OPTIONALLY, FILTER THE SCRAMBLED MESSAGE TO REMOVE EXTRANEOUS CHARACTERS
204
DETERMINE WHETHER THE SCRAMBLED MESSAGE IS STRUCTURALLY SOUND
206
208
STRUCTURALLY SOUND?
YES
210
RETAIN THE RESPONSE
NO
DETECT EMBEDDED RESPONSES
212
DISCOVER ANY STREAMED EMBEDDED RESPONSES
214
216
YES
ALL RESPONSES VALIDATE?
NO
DISCOVER ANY INTERLEAVED EMBEDDED RESPONSES
218
220
ALL RESPONSES VALIDATE?
NO
222
DISCARD ALL EMBEDDED RESPONSES
YES
RETAIN ALL EMBEDDED RESPONSES
224
END
226

FIG. 2

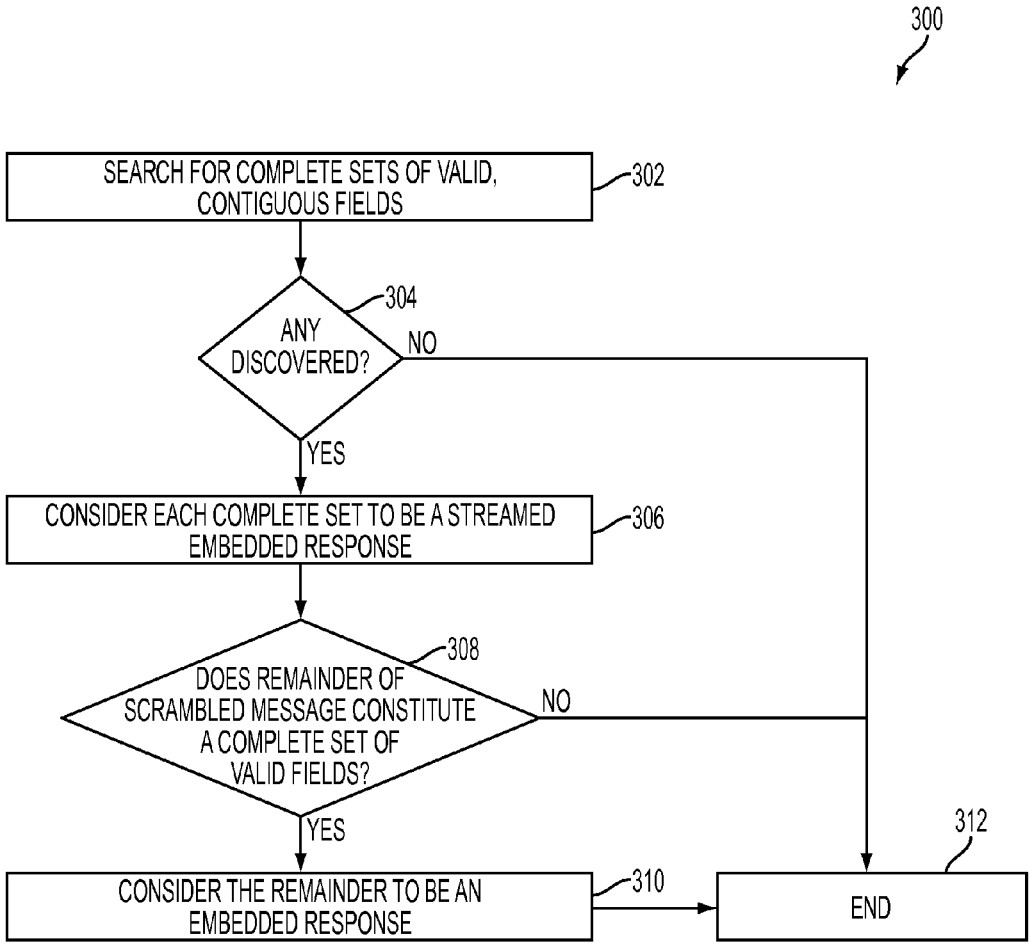

300
SEARCH FOR COMPLETE SETS OF VALID, CONTIGUOUS FIELDS
302
ANY DISCOVERED?
304
NO
YES
CONSIDER EACH COMPLETE SET TO BE A STREAMED EMBEDDED RESPONSE
306
DOES REMAINDER OF SCRAMBLED MESSAGE CONSTITUTE A COMPLETE SET OF VALID FIELDS?
308
NO
YES
CONSIDER THE REMAINDER TO BE AN EMBEDDED RESPONSE
310
END
312

FIG. 3

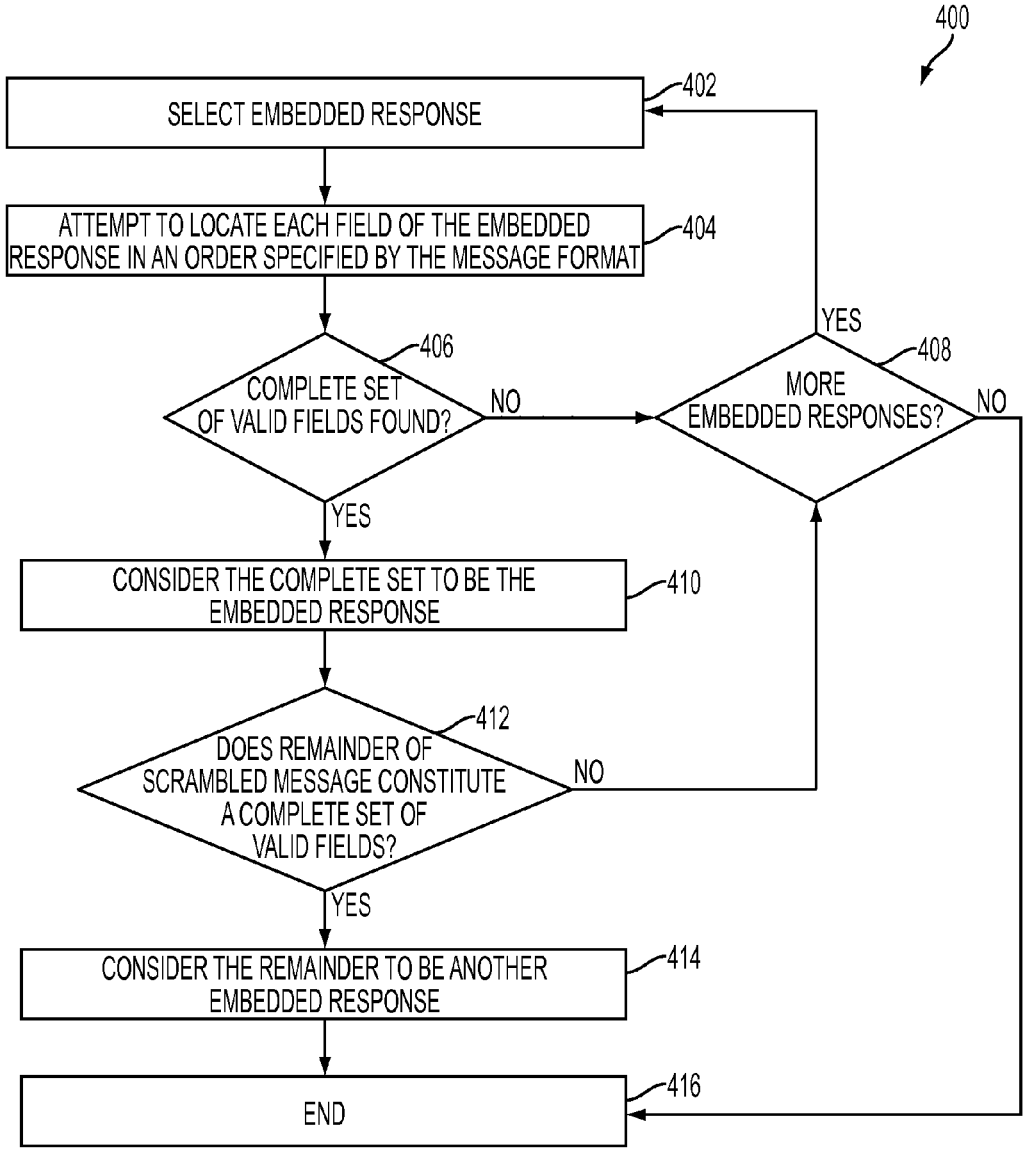

400
SELECT EMBEDDED RESPONSE
402
ATTEMPT TO LOCATE EACH FIELD OF THE EMBEDDED RESPONSE IN AN ORDER SPECIFIED BY THE MESSAGE FORMAT
404
COMPLETE SET OF VALID FIELDS FOUND?
406
NO
YES
MORE EMBEDDED RESPONSES?
408
YES
NO
CONSIDER THE COMPLETE SET TO BE THE EMBEDDED RESPONSE
410
DOES REMAINDER OF SCRAMBLED MESSAGE CONSTITUTE A COMPLETE SET OF VALID FIELDS?
412
NO
YES
CONSIDER THE REMAINDER TO BE ANOTHER EMBEDDED RESPONSE
414
END
416

FIG. 4

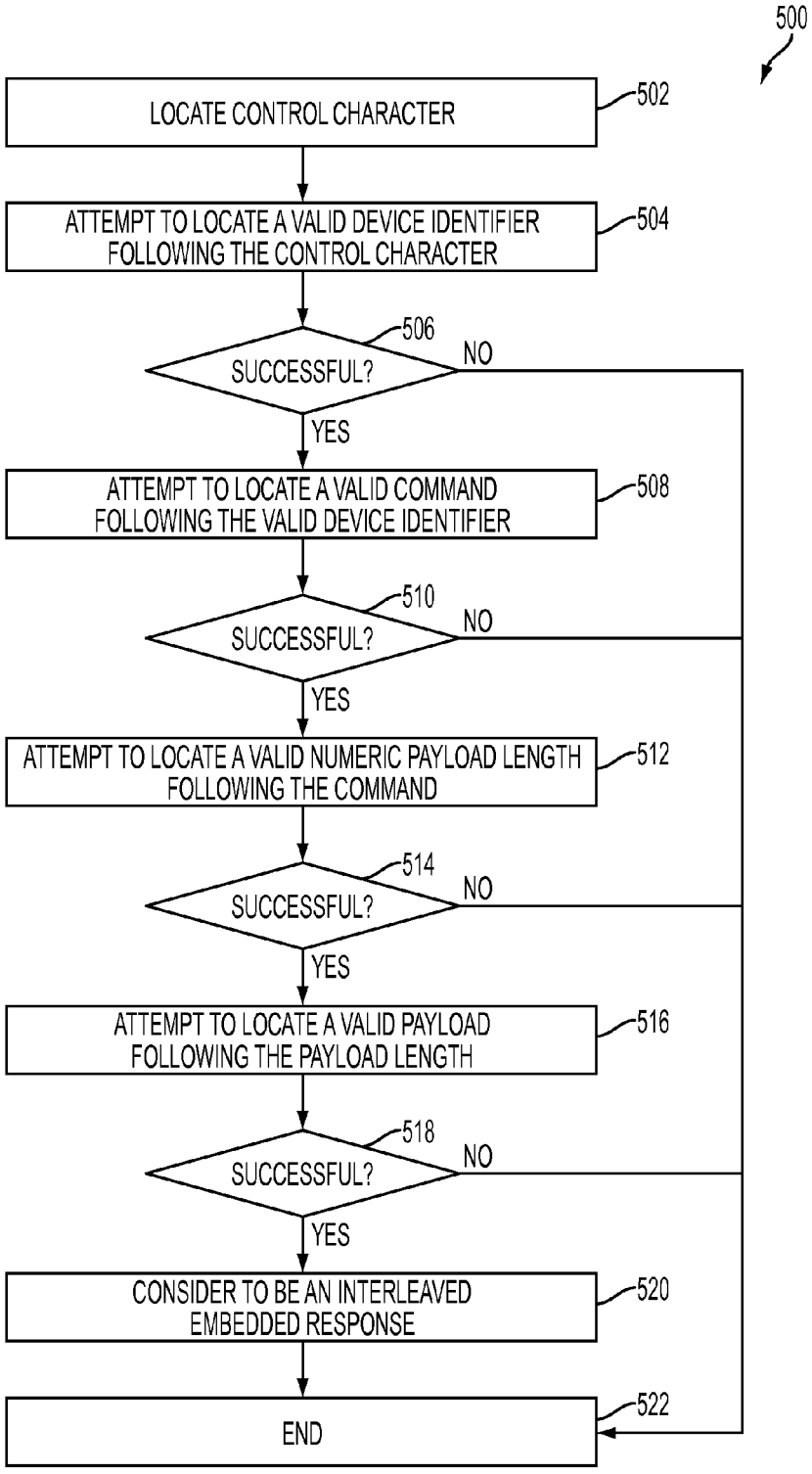

500
LOCATE CONTROL CHARACTER
502
ATTEMPT TO LOCATE A VALID DEVICE IDENTIFIER FOLLOWING THE CONTROL CHARACTER
504
506
SUCCESSFUL?
NO
YES
ATTEMPT TO LOCATE A VALID COMMAND FOLLOWING THE VALID DEVICE IDENTIFIER
508
510
SUCCESSFUL?
NO
YES
ATTEMPT TO LOCATE A VALID NUMERIC PAYLOAD LENGTH FOLLOWING THE COMMAND
512
514
SUCCESSFUL?
NO
YES
ATTEMPT TO LOCATE A VALID PAYLOAD FOLLOWING THE PAYLOAD LENGTH
516
518
SUCCESSFUL?
NO
YES
CONSIDER TO BE AN INTERLEAVED EMBEDDED RESPONSE
520
END
522

FIG. 5

SYSTEM AND METHOD FOR CORRECTING SCRAMBLED MESSAGES

BACKGROUND

1. Technical Field

The present invention relates generally to network error correction and more particularly, but not by way of limitation, to systems and methods for correcting scrambled messages.

2. History of Related Art

On a communications network, a monitoring node may periodically issue commands to monitored devices. The commands typically request certain data such as, for example, a firmware version, a status, or other information. In response, the monitored devices typically transmit messages (i.e., responses) that provide the requested data. Oftentimes, particularly in communications networks such as radio networks and serial-communication networks, network unreliability and/or environmental conditions can cause the messages to arrive scrambled. That is, the messages may no longer conform to a sequence of fields required by a message format. For example, a single scrambled message may contain noise, have multiple distinct messages randomly interleaved therein, etc. Traditionally, scrambled messages are handled utilizing a combination of checksums and retransmissions. For the most part, scrambled messages must be discarded.

Moreover, as the value and use of information continues to increase, individuals and businesses seek additional ways to process and store information. One option available to users is information handling systems. An information handling system generally processes, compiles, stores, and/or communicates information or data for business, personal, or other purposes thereby allowing users to take advantage of the value of the information. Because technology and information handling needs and requirements vary between different users or applications, information handling systems may also vary regarding what information is handled, how the information is handled, how much information is processed, stored, or communicated, and how quickly and efficiently the information may be processed, stored, or communicated. The variations in information handling systems allow for information handling systems to be general or configured for a specific user or specific use such as financial transaction processing, airline reservations, enterprise data storage, or global communications. In addition, information handling systems may include a variety of hardware and software components that may be configured to process, store, and communicate information and may include one or more computer systems, data storage systems, and networking systems.

SUMMARY OF THE INVENTION

In one embodiment, a method comprises, on an information handling system, receiving a scrambled message over a network connection, detecting, by the information handling system, one or more embedded responses in the scrambled message. The method further includes discovering, by the information handling system, any streamed embedded responses of the one or more embedded responses. In addition, the method includes, responsive to the discovering of any streamed embedded responses, determining whether all of the one or more embedded responses validate. The method also includes, responsive to a determination that fewer than all of the one or more embedded responses validate, discovering, by the information handling system, any interleaved embedded responses of the one or more embedded responses. The method additionally includes, responsive to the discovering of any interleaved embedded responses, determining whether all of the one or more embedded responses validate. Furthermore, the method includes, responsive to a determination that all of the one or more embedded responses validate, the information handling system retaining the one or more responses.

In one embodiment, an information handling system includes a processing unit. The processing unit is operable to implement a method. The method includes receiving a scrambled message over a network connection. The method further includes detecting one or more embedded responses in the scrambled message. In addition, the method includes discovering any streamed embedded responses of the one or more embedded responses. Further, the method includes, responsive to the discovering of any streamed embedded responses, determining whether all of the one or more embedded responses validate. Moreover, the method includes, responsive to a determination that fewer than all of the one or more embedded responses validate, discovering any interleaved embedded responses of the one or more embedded responses. The method also includes, responsive to the discovering of any interleaved embedded responses, determining whether all of the one or more embedded responses validate. Additionally, the method includes, responsive to a determination that all of the one or more embedded responses validate, retaining the one or more responses.

In one embodiment, a computer-program product includes a computer-usable medium having computer-readable program code embodied therein. The computer-readable program code is adapted to be executed to implement a method. The method includes receiving a scrambled message over a network connection. The method further includes detecting one or more embedded responses in the scrambled message. In addition, the method includes discovering any streamed embedded responses of the one or more embedded responses. Further, the method includes, responsive to the discovering of any streamed embedded responses, determining whether all of the one or more embedded responses validate. Moreover, the method includes, responsive to a determination that fewer than all of the one or more embedded responses validate, discovering any interleaved embedded responses of the one or more embedded responses. The method also includes, responsive to the discovering of any interleaved embedded responses, determining whether all of the one or more embedded responses validate. Additionally, the method includes, responsive to a determination that all of the one or more embedded responses validate, retaining the one or more responses.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the method and apparatus of the present invention may be obtained by reference to the following Detailed Description when taken in conjunction with the accompanying Drawings wherein:

FIG. **1** illustrates a system for detecting and correcting scrambled messages;

FIG. **2** illustrates a process for correcting scrambled messages;

FIG. **3** illustrates a process for discovering streamed embedded responses;

FIG. **4** illustrates a process for discovering interleaved embedded responses; and

FIG. **5** illustrates a process for attempting to locate each field of an embedded response.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS OF THE INVENTION

In various embodiments, scrambled messages can better detected and corrected via principles described herein. A scrambled message, as used herein, refers to a message that does not conform to a message format. A message format, as used herein, refers to predetermined spatial or time-sequential arrangements of parts of a message. The parts of a message may be referred to herein as fields.

For purposes of this disclosure, an information handling system may include any instrumentality or aggregate of instrumentalities operable to compute, calculate, determine, classify, process, transmit, receive, retrieve, originate, switch, store, display, communicate, manifest, detect, record, reproduce, handle, or utilize any form of information, intelligence, or data for business, scientific, control, or other purposes. For example, an information handling system may be a personal computer (e.g., desktop or laptop), tablet computer, mobile device (e.g., personal digital assistant (PDA) or smart phone), server (e.g., blade server or rack server), a network storage device, or any other suitable device and may vary in size, shape, performance, functionality, and price. The information handling system may include random access memory (RAM), one or more processing resources such as a central processing unit (CPU) or hardware or software control logic, ROM, and/or other types of nonvolatile memory. Additional components of the information handling system may include one or more disk drives, one or more network ports for communicating with external devices as well as various input and output (I/O) devices, such as a keyboard, a mouse, touchscreen and/or a video display. The information handling system may also include one or more buses operable to transmit communications between the various hardware components.

FIG. **1** illustrates a system **100** for detecting and correcting scrambled messages. The system **100** includes a monitoring system **102** communicating with a plurality of monitored information handling systems **110** over a communications network **108**. In some embodiments, the monitoring system **102** monitors and controls the monitored information handling systems **110**. For example, in various embodiments, the monitoring system **102** may encompass an industrial control system such as, for example, a supervisory control and data acquisition (SCADA) system or a distributed control system (DCS). In various other embodiments, the monitoring system **102** is merely representative of network node at which messages may be received. In these embodiments, the monitoring system **102** is not necessarily distinct from the monitored information handling systems **110**.

It should be appreciated that the network **108** is intended to abstract a plurality of networks over which the monitoring system **102** may be operable to communicate. In particular, the network **108** logically represents all communication infrastructure for connecting the monitoring system **102** to each of the monitored information handling systems **110**. The network **108** can include any number of wired and/or wireless communications networks such as, for example, public or private intranets, the Internet, public switched telephone networks (PSTNs), cellular networks, satellite communication, and the like. To the extent a particular information handling system of the monitored information handling systems **110** connects to the monitoring system **102** through others of the monitored information handling systems **110**, for purposes of communication between the monitoring system **102** and the particular information handling system, the network **108** can be considered to include those other information handling systems.

The monitored information handling systems **110** can include, for example, field devices (e.g., programmable logic controllers (PLCs)) that control or monitor local operations such as opening and closing valves and breakers, sensor systems, remote terminal units (RTUs) that connect to and gather data from sensor systems, and the like. The monitored information handling systems **110** can also include, for example, server computers, desktop computers, laptop computers, tablet computers, and smartphones. The monitored information handling systems **110** can also include networking equipment such as, for example, routers, switches, wireless access points, and the like. In various embodiments, subsets of the monitored information handling systems **110** may be interconnected. Each interconnected subset may be arranged into a network topology that has, for example, a tree structure. In this manner, some of the monitored information handling systems **110** may be effectively dependent upon others of the monitored information handling systems **110**. The monitored information handling systems **110** may also be geographically dispersed on a global level.

The monitoring system **102** is operable to periodically issue commands to the monitored information handling systems **110** over the communications network **108**. The commands may request certain data such as, for example, a status, a firmware version, or other information. The monitored information handling systems **110**, in turn, are operable to transmit responses, often asynchronously, over the network **108**. In a typical embodiment, the monitoring system **102** is operable to detect and correct when one or more of the responses arrive as scrambled messages. Examples will be described with respect to FIGS. **2-5**.

FIG. **2** illustrates a process **200** for correcting scrambled messages. In a typical embodiment, the process **200** is performed by a monitoring system such as, for example, the monitoring system **102** of FIG. **1**. The process **200** begins at step **202**. At step **202**, the monitoring system receives a scrambled message. In a typical embodiment, the scrambled message may contain one or more responses to an original command issued by the monitoring system. In some embodiments, a step of identifying a message as scrambled may be subsumed within step **202**. From step **202**, the process **200** proceeds to step **204**.

At step **204**, the monitoring system optionally filters the scrambled message to remove extraneous characters. What constitutes extraneous characters can vary depending on a particular implementation. For example, if a message format specifies that only a predefined set of characters be used, any characters that are not part of the predefined set may be considered noise and removed. For instance, some message formats may specify that hexadecimal characters be exclusively used. In these embodiments, any characters that are not hexadecimal characters may be removed at step **204**. From step **204**, the process **200** proceeds to step **206**.

At step **206**, the monitoring system determines whether the scrambled message is structurally sound. In a typical embodiment, the scrambled message is considered structurally sound if, after any filtering at step **202**, the scrambled message conforms to a sequence of fields specified by the message format (i.e., is no longer scrambled). If it is determined at step **208** that the scrambled message is structurally sound, the process **200** proceeds to step **210**. At step **210**, the scrambled message is retained. From step **210**, the process **200** proceeds to step **226** and ends.

If it is determined at step **208** that the scrambled message is not structurally sound, the process **200** proceeds to step **212**. At step **212**, the monitoring system detects one or more embedded responses in the scrambled message. The detection

typically involves determining how many responses are embedded within the scrambled message. In certain embodiments, responses can be detected by scanning for response indicators. In a typical embodiment, response indicators are codes, characters, or other types of values that only occur once per response. The response indicators may be, for example, response-start indicators or response-end indicators. Response-start indicators may be, for example, a control code or character that indicates a beginning of a response. Response-end indicators may be, for example, a control code or character that indicates an end of a response. From step **212**, the process **200** proceeds to step **214**.

At step **214**, the monitoring system attempts to discover any streamed embedded responses. A streamed embedded response is a valid response that appears contiguously in the scrambled message without interruption by noise or other characters such as, for example, portions of another response. More particularly, a streamed embedded response generally includes a complete, contiguous set of fields in an order specified by the message format. For example, suppose the scrambled message contained "aaabbbbbbaaa." If "bbbbbb" were a valid, intended response, "bbbbbb" would be considered a streamed embedded response. Additionally, identification of "bbbbbb" as a streamed embedded response would enable identification of "aaaaaa" as an embedded response. An example of discovering streamed embedded responses will be described in more detail with respect to FIG. **3**.

From step **214**, the process **200** proceeds to step **216**. At step **216**, the monitoring system determines whether all responses embedded within the scrambled message successfully validate following the discovery at step **214**. In a typical embodiment, all responses are determined to successfully validate if a total number of discovered embedded responses equals a total number of embedded responses that were detected at step **212**. If it is determined at step **216** that all responses embedded within the scrambled message successfully validate, the process **200** proceeds to step **224**. At step **224**, all embedded responses are retained. From step **224**, the process **200** proceeds to step **226** and ends.

If it is determined at step **216** that fewer than all responses within the scrambled message successfully validate, the process **200** proceeds to step **218**. At step **218**, the monitoring system attempts to discover any interleaved embedded responses. An interleaved embedded response is a response that is entirely contained within the scrambled message but is not contiguous. For example, suppose the scramble message contained "aabbaabbaabb." If "aaaaaa" and "bbbbbb" were intended responses, each intended response would be considered an interleaved embedded message. In some embodiments, the discovery at step **218** is performed with respect to an entirety of the scrambled message and ignores any embedded messages discovered at step **214**. In other embodiments, the discovery at step **218** leverages any embedded responses already discovered at step **214** and only conducts discovery with respect to a remainder of the scrambled message. Examples of discovering interleaved embedded responses will be described with respect to FIGS. **4-5**.

From step **218**, the process **200** proceeds to step **220**. At step **220**, the monitoring system determines whether all embedded responses successfully validate following the discovery at step **218**. In a typical embodiment, all responses are determined to successfully validate if a total number of discovered embedded responses equals a total number of embedded responses that were detected at step **212**. If it is determined at step **220** that all embedded responses successfully validate, the process **200** proceeds to step **224**. At step **224**, all embedded responses are retained as described above. From step **224**, the process **200** proceeds to step **226** and ends.

If it is determined at step **220** that fewer than all responses within the scrambled message successfully validate, the process **200** proceeds to step **222**. At step **222**, all embedded responses are discarded. Although the process **200** describes the embedded responses as being discarded for purposes of illustration, in some embodiments, a higher error tolerance may enable some of the embedded responses to be retained and used. From step **222**, the process **200** proceeds to step **226** and ends.

It should be appreciated that the order and arrangement of steps in the process **200** is presented as an example of inventive principles. In various embodiments, various steps may be omitted, modified, or rearranged. For example, in some embodiments, the discovery of streamed embedded responses at step **212** may be omitted. Rather, the discovery described with respect to step **214** may be relied upon for both streamed embedded responses and interleaved embedded responses. Other modifications and optimizations will be apparent to one of ordinary skill in the art after reviewing the inventive principles described herein.

FIG. **3** illustrates a process **300** for discovering streamed embedded responses. The process **300** may be performed by a monitoring system such as, for example, the monitoring system **102** of FIG. **1**. For example, the process **300** may be performed as all or part of step **214** of the process **200** of FIG. **2**. The process **300** begins at step **302**.

At step **302**, the monitoring system searches for complete sets of valid, contiguous fields. In a typical embodiment, the monitoring system checks each embedded response detected, for example, at step **212** of the process **200**, beginning with the embedded response's response-start indicator. An example of how a set of fields may be considered valid will be described relative to interleaved embedded responses with respect to FIG. **5**. From step **302**, the process **300** proceeds to step **304**. At step **304**, the monitoring system determines whether any complete sets of valid, contiguous fields were discovered at step **302**. If it is determined at step **304** that no complete sets of valid, contiguous fields were discovered, the process **300** proceeds to step **312** and ends. If it is determined at step **304** that at least one complete set of valid, contiguous fields was discovered, the process **300** proceeds to step **306**.

At step **306**, each complete set is considered to be a streamed embedded response. From step **306**, the process **300** proceeds to step **308**. At step **308**, the monitoring system determines whether a remainder of the scrambled message constitutes a complete set of valid fields. The remainder generally encompasses the scrambled message without any streamed embedded responses. If it is determined at step **308** that that the remainder of the scrambled message constitutes a complete set of valid fields, the process **300** proceeds to step **310**. At step **310**, the remainder of the scrambled message is considered to be an embedded response. From step **310**, the process **300** proceeds to step **312** and ends. If it is determined at step **308** that the remainder of the scrambled message does not constitute a complete set of valid fields, the process **300** proceeds to step **312** and ends.

FIG. **4** illustrates a process **400** for discovering interleaved embedded responses. The process **400** may be performed by a monitoring system such as, for example, the monitoring system **102** of FIG. **1**. The process **400** may be performed as all or part of step **218** of the process **200** of FIG. **2**. In a typical embodiment, the process **400** iterates through each embedded response detected, for example, at step **212** of the process **200**. In embodiments in which the process **400** is conducted with respect to only a portion of a scrambled message as

described with respect to FIG. **2**, the monitoring system may iterate through only those embedded responses that were not discovered, for example, as streamed embedded responses during a process such as the process **300** of FIG. **3**. The process **400** begins at step **402**.

At step **402**, the monitoring system selects an embedded response. From step **402**, the process **400** proceeds to step **404**. At step **404**, the monitoring system attempts to validly locate each field of the embedded response in an order specified by the message format. Typically, the monitoring system looks for a complete set of fields that is internally consistent, conforms to a format and sequence specified by the message format, complies with the monitoring system's expectations for each field's value, corresponds to an original command issued by the monitoring system, and/or meets other requirements. An example will be described with respect to FIG. **5**. From step **404**, the process **400** proceeds to step **406**.

At step **406**, the monitoring system determines whether a complete set of valid fields was located at step **404**. If it is determined at step **406** that a complete set of valid fields was not found, the process **400** proceeds directly to step **408** (described below). If it is determined at step **406** that a complete set of valid fields was found, the process **400** proceeds to step **410**. At step **410**, the complete set is deemed to constitute the embedded response. From step **410**, the process **400** proceeds to step **412**.

At step **412**, the monitoring system determines whether a remainder of the scrambled message constitutes a complete set of valid fields. The remainder generally encompasses the scrambled message without any interleaved embedded responses. If it is determined at step **412** that that the remainder of the scrambled message constitutes a complete set of valid fields, the process **400** proceeds to step **414**. At step **414**, the remainder of the scrambled message is considered to be another embedded response. From step **414**, the process **400** proceeds to step **416** and ends. If it is determined at step **412** that the remainder of the scrambled message does not constitute a complete set of valid fields, the process **400** proceeds to step **408**.

At step **408**, the monitoring system determines whether there are additional embedded responses through which the process **400** has not yet iterated. If so, the process **400** returns to step **402** for selection of another embedded response. If it is determined at step **410** that there are no additional embedded responses through which the process **400** has not yet iterated, the process **400** proceeds to step **412**. At step **412**, the process **400** ends.

As described above, a message format can take numerous forms. For illustrative purposes, an example of a message format will now be described. It should be appreciated that this example is being described solely for purposes of explaining various inventive principles to one of ordinary skill in the art. Table 1 below lists fields of an exemplary message format. The exemplary message format specifies a length of each field and a field sequence (i.e., the order in which the fields are listed in Table 1). Message formats can take numerous other forms without deviating from the principles described herein. For example, in place of a payload-length field, various embodiments may rely on a control code or character that signifies an end of a message. In these embodiments, the control code or character could indicate an end of an applicable payload, thereby eliminating a need for the payload-length field.

TABLE 1

FIELD	LENGTH	DESCRIPTION
Control Code	1 byte	Indicates a start of a response and may indicate a message type. For example, the control code can be one of the following set: m, n, o, p, q.
Device Identifier	2 bytes	Identifies a device that sent a response (e.g., in hexadecimal format).
Command Code	2 bytes	Identifies a command (e.g., in hexadecimal format).
Payload Length	2 byte	A length of the payload (e.g., in hexadecimal format).
Payload	Variable	Data such as, for example, data responsive to a command from a monitoring system (e.g., in hexadecimal format).

FIG. **5** illustrates a process **500** for attempting to locate each field of an embedded response in a scrambled message. The process **500** may be performed by a monitoring system such as, for example, the monitoring system **102** of FIG. **1**. The process **500** may be performed as all or part of step **404** of the process **400** of FIG. **4**. For purposes of illustration, the process **500** operates with respect to the exemplary message format described above with respect to Table 1. The process **500** begins at step **502**.

At step **502**, the monitoring system locates a control character In a typical embodiment, the control character is a response-start indicator that served as the basis for detecting embedded responses as described, for example, with respect to step **212** of the process **200** of FIG. **2**. Therefore, in a typical embodiment, step **502** involves locating a previously detected control character. As indicated in Table 1, the exemplary message format specifies that a response begins with a control character that must be 'm', 'n', 'o', 'p,' or 'q.' From step **502**, the process **500** proceeds to step **504**.

At step **504**, the monitoring system attempts to locate a valid device identifier following the control character. For purposes of the process **500**, a valid device identifier is considered an address or other series of numbers and/or characters that identifies a device from which a response is expected. For example, a response may be expected due to a command issued by the monitoring system to the device. From step **504**, the process **500** proceeds to step **506**. At step **506**, it is determined whether the monitoring system has successfully identified a valid device identifier. If not, the process **500** proceeds to step **522** and ends. Alternatively, if it is determined at step **506** that the monitoring system has successfully identified a valid device identifier, the process **500** proceeds to step **508**.

At step **508**, the monitoring system attempts to locate in the scrambled message a valid command following the valid device identifier. A valid command typically must correspond to, and be responsive to, an original command that was issued by the monitoring system to whatever device is identified by the valid device identifier. From step **508**, the process **500** proceeds to step **510**. At step **510**, it is determined whether the monitoring system has successfully identified a valid command. If not, the process **500** proceeds to step **522** and ends. Alternatively, if it is determined at step **510** that the monitoring system has successfully identified a valid command, the process **500** proceeds to step **512**.

At step **512**, the monitoring system attempts to locate in the scrambled message a valid payload length following the valid command. In a typical embodiment, a valid payload length specifies a length such as, for example, a number of bytes, that makes sense given the valid command. For example, as long as a payload of a given length could be considered valid, the

given length may be considered a valid payload length. From step **512**, the process **500** proceeds to step **514**. At step **514**, it is determined whether the monitoring system has successfully identified a valid payload length. If not, the process **500** proceeds to step **522** and ends. Alternatively, if it is determined at step **514** that the monitoring system has successfully identified a valid command, the process **500** proceeds to step **516**.

At step **516**, the monitoring system attempts to locate in the scrambled message a valid payload following the valid payload length. In a typical embodiment, a payload is considered a valid payload if it is of the valid payload length and has a value that is appropriate given the valid command and/or given the original command issued by the monitoring system. For example, given the valid command, the payload may be expected to satisfy certain criteria such as, for example, having a particular value, having a value selected from a particular set of values, falling within a particular range of values, and/or the like. From step **516**, the process **500** proceeds to step **518**.

At step **518**, it is determined whether the monitoring system has successfully identified a valid payload. If not, the process **500** proceeds to step **522** and ends. Alternatively, if it is determined at step **518** that the monitoring system has successfully identified a valid payload, the process **500** proceeds to step **520**. At step **520**, a set of fields defined by the valid device identifier, the valid command, the valid payload length, and the valid payload is considered to be an interleaved embedded response. From step **520**, the process **500** proceeds to step **522**. At step **522**, the process **500** ends.

In a typical embodiment, the process **500** may be performed for each embedded response as described with respect to the process **400**. For example, suppose a particular scrambled message is defined by "mFEm00FD02007E02625D33." According to this example, each 'm' is a control code that serves as a response-start indicator (i.e., at index zero and index three). When performing the process **500** with respect to the particular scrambled message, the monitoring system may identify "FD," "00," "02" and "5D33" as a valid device identifier, a valid command, a valid payload length, and a valid payload, respectively. Therefore, "FD00025D33" may be considered to be an interleaved embedded response. As result of the discovery of the interleaved embedded response, the monitoring system may identify "FE," "00," "02" and "7E62" as a valid device identifier, a valid command, a valid payload length, and a valid payload, respectively. Therefore, "FE00027E62" may be considered to be another embedded response as described with respect to step **414** of FIG. **4**.

Although various embodiments of the method and apparatus of the present invention have been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth herein.

What is claimed is:

1. A method comprising:

on an information handling system, receiving a scrambled message over a network connection;

detecting, by the information handling system, one or more embedded responses in the scrambled message;

discovering, by the information handling system, any streamed embedded responses of the one or more embedded responses;

responsive to the discovering of any streamed embedded responses, determining whether all of the one or more embedded responses validate;

responsive to a determination that fewer than all of the one or more embedded responses validate, discovering, by the information handling system, any interleaved embedded responses of the one or more embedded responses;

responsive to the discovering of any interleaved embedded responses, determining whether all of the one or more embedded responses validate; and

responsive to a determination that all of the one or more embedded responses validate, the information handling system retaining the one or more responses.

2. The method of claim **1**, comprising, prior to the detecting, filtering the scrambled message to remove extraneous characters.

3. The method of claim **2**, wherein the extraneous characters comprise any characters that are non-hexadecimal characters.

4. The method of claim **2**, comprising:

responsive to the filtering, determining whether the filtered scrambled message is structurally sound;

retaining the filtered scrambled message as a response if the filtered scrambled message is determined to be structurally sound; and

wherein the detecting is only performed responsive to a determination that the filtered scrambled message is not structurally sound.

5. The method of claim **1**, wherein the detecting comprises scanning the scrambled message for one or more response indicators, the one or more response-start indicators selected from the group consisting of: response-start indicators and response-end indicators.

6. The method of claim **1**, wherein the discovering of streamed embedded responses comprises:

searching the scrambled message for one or more complete sets of valid and contiguous fields;

considering each complete set to be a streamed embedded response; and

responsive to a determination that a remainder of the scrambled message constitutes a complete set of valid fields, considering the remainder to constitute one of the one or more embedded responses.

7. The method of claim **1**, wherein the discovering of interleaved embedded responses comprises, for at least one embedded response of the one or more embedded responses:

attempting to locate in the scrambled message each field of the at least one embedded response in an order specified by a message format; and

responsive to a determination that a complete set of valid fields has been found, considering the complete set to be the at least one embedded response.

8. The method of claim **7**, wherein the discovering of interleaved embedded responses comprises, responsive to a determination that a remainder of the scrambled message constitutes a complete set of valid fields, considering the remainder to constitute another of the one or more embedded responses.

9. The method of claim **7**, wherein the discovering of interleaved embedded responses iterates through each embedded response of the one or more embedded responses.

10. The method of claim **7**, wherein the attempting to locate comprises attempting to locate a response-start indicator, a device identifier, a payload length, and a payload.

11. The method of claim **7**, wherein the attempting to locate comprises:

locating in the scrambled message a response-start indicator;

locating in the scrambled message a valid device identifier following the response-start indicator;

locating a valid command following the valid device identifier;

locating a valid payload length following the command;

locating a valid payload following the payload length; and

considering the response-start indicator, the valid device identifier, the valid command, the valid payload length, and the valid payload to constitute an interleaved embedded response.

12. An information handling system, comprising:

a processing unit, wherein the processing unit is operable to implement a method comprising:

receiving a scrambled message over a network connection;

detecting one or more embedded responses in the scrambled message;

discovering any streamed embedded responses of the one or more embedded responses;

responsive to the discovering of any streamed embedded responses, determining whether all of the one or more embedded responses validate;

responsive to a determination that fewer than all of the one or more embedded responses validate, discovering any interleaved embedded responses of the one or more embedded responses;

responsive to the discovering of any interleaved embedded responses, determining whether all of the one or more embedded responses validate; and

responsive to a determination that all of the one or more embedded responses validate, retaining the one or more responses.

13. The information handling system of claim **12**, the method comprising, prior to the detecting, filtering the scrambled message to remove extraneous characters.

14. The information handling system of claim **13**, the method comprising:

responsive to the filtering, determining whether the filtered scrambled message is structurally sound;

retaining the filtered scrambled message as a response if the filtered scrambled message is determined to be structurally sound; and

wherein the detecting is only performed responsive to a determination that the filtered scrambled message is not structurally sound.

15. The information handling system of claim **12**, wherein the detecting comprises scanning the scrambled message for one or more response indicators, the one or more response-start indicators selected from the group consisting of: response-start indicators and response-end indicators.

16. The information handling system of claim **12**, wherein the discovering of streamed embedded responses comprises:

searching the scrambled message for one or more complete sets of valid and contiguous fields;

considering each complete set to be a streamed embedded response; and

responsive to a determination that a remainder of the scrambled message constitutes a complete set of valid fields, considering the remainder to constitute one of the one or more embedded responses.

17. The information handling system of claim **12**, wherein the discovering of interleaved embedded responses comprises, for at least one embedded response of the one or more embedded responses:

attempting to locate in the scrambled message each field of the at least one embedded response in an order specified by a message format;

responsive to a determination that a complete set of valid fields has been found, considering the complete set to be the at least one embedded response; and

responsive to a determination that a remainder of the scrambled message constitutes a complete set of valid fields, considering the remainder to constitute another of the one or more embedded responses.

18. The information handling system of claim **17**, wherein the attempting to locate comprises attempting to locate a response-start indicator, a device identifier, a payload length, and a payload.

19. The information handling system of claim **17**, wherein the attempting to locate comprises:

locating in the scrambled message a response-start indicator;

locating in the scrambled message a valid device identifier following the response-start indicator;

locating a valid command following the valid device identifier;

locating a valid payload length following the command;

locating a valid payload following the payload length; and

considering the response-start indicator, the valid device identifier, the valid command, the valid payload length, and the valid payload to constitute an interleaved embedded response.

20. A computer-program product comprising a non-transitory computer-usable medium having computer-readable program code embodied therein, the computer-readable program code adapted to be executed to implement a method comprising:

receiving a scrambled message over a network connection;

detecting one or more embedded responses in the scrambled message;

discovering any streamed embedded responses of the one or more embedded responses;

responsive to the discovering of any streamed embedded responses, determining whether all of the one or more embedded responses validate;

responsive to a determination that fewer than all of the one or more embedded responses validate, discovering any interleaved embedded responses of the one or more embedded responses;

responsive to the discovering of any interleaved embedded responses, determining whether all of the one or more embedded responses validate; and

responsive to a determination that all of the one or more embedded responses validate, retaining the one or more responses.

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